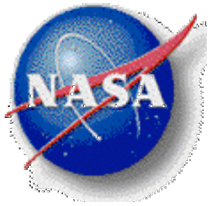

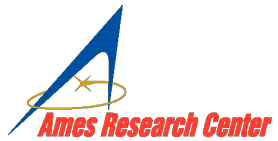

Simulator Evaluation of System Developed with the Human-Automation Design and Analysis Methodology

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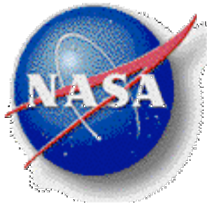
Lance Sherry
San Jose State University Foundation

Arash Aghevli
QSS Corporation

Project background

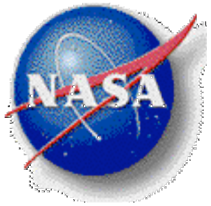
- Milestone Element of NASA Airspace Systems Human - Automation Design Methods and Tools (HADMT) project focusing on aviation automation and interface design tools

- Goal of project is to provide methods and tools to the aviation automation design community



Contents

- Tool Background
- Tool Development
- Progress to date



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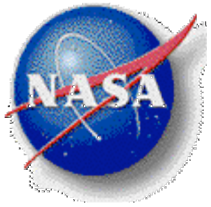
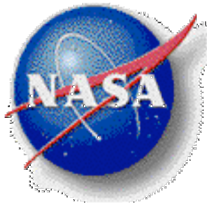


Issues

- Current HCI Evaluation Methods/Tools do not have wide acceptance in aviation automation design community without mandates, most likely because there is additional cost (time and $) with little perceived benefit

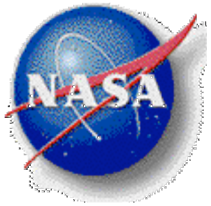
- Human Computer Interaction (HCI) Evaluation for automation needs to be addressed earlier in the design process (FAA HFT, 1996, etc.)

Result: Need to give *useful* HCI evaluation tools and techniques to designers/engineers that can be integrated early into mainstream engineering processes



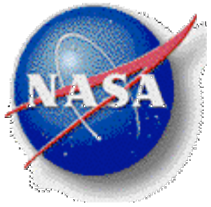
Working Definition: *Useful* HCI Design Tool

- Reduces Costs: Minimize training or interpretation requirements to evaluate devices and provide useful evaluations
- Supports Iteration: Provide rapid build - evaluation cycles
- Integrates HCI Evaluation: Minimize additional steps for designer to evaluate during design
- Comprehensive: Interface evaluation must examine all machine behaviors/tasks, not just those seen on the interface
- Provides Scalability: Ability to build and evaluate complex, dynamic devices

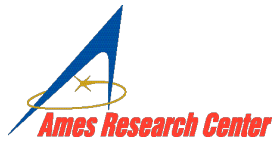


Tool User Group

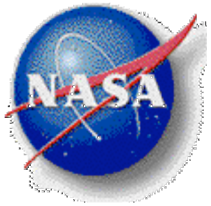
- Targeted design stage: Requirements Specification
- Support is needed to uncover operational design decisions in Requirements Specification stage.
  - Decisions not addressed in Requirements Specification will be encountered in software development, and software developers are not required to have aviation design expertise
- Users in Requirements Specification stage are domain experts
- Domain experts may not have programming or HCI Evaluation expertise



Tool Requirements Summary



- Need a tool which domain experts in requirements specification process without programming or HCI Evaluation expertise can learn to use in hours or days of training, not weeks or months (Reduce costs)
- Need a tool which supports rapid, iterative build - evaluate cycles from the beginning of the design process
- Need a tool which can be used as a platform for other HCI analyses (integrated HCI)
- Need a tool which allows domain experts to develop the machine behavior, and connect the machine behaviors to the User Interface (comprehensive)
- Need a tool which allows users to build real world, complex devices (Scalability)



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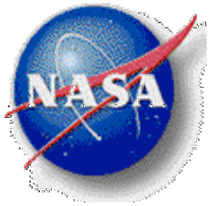
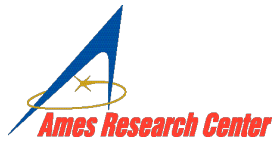


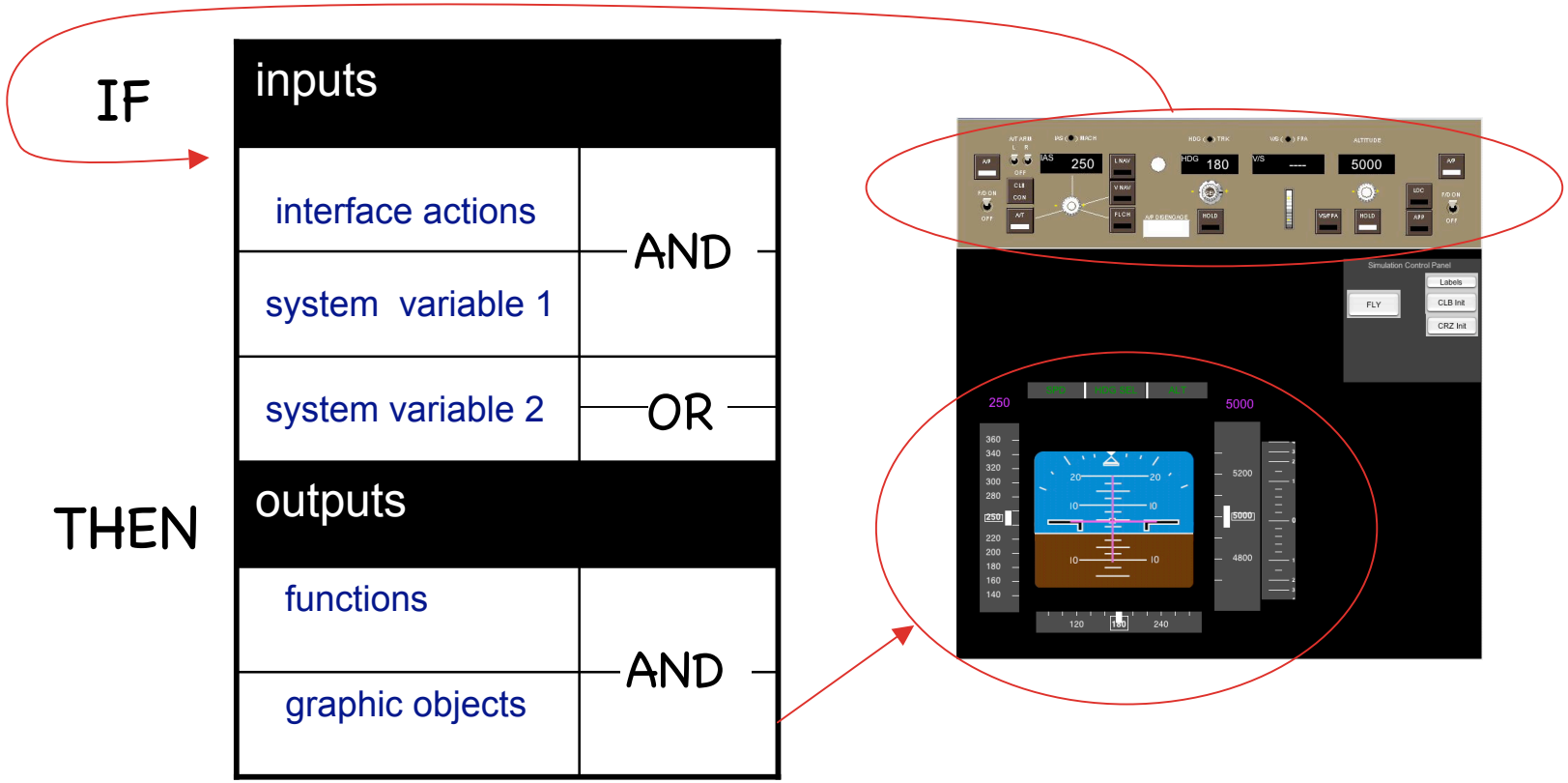
Tool Foundation

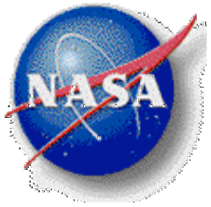


- Based on Operational Procedure Tables Method (Sherry, 1995)
- Method has been used by domain experts but with support
- Used successfully by avionics manufacturers for the design of Autopilot and FMS software (complex/hybrid systems)for in many commercial aircraft (Airbus, Boeing, McDonnell Douglas)
- Challenge: extend advantages of method through tool to domain experts with as little training/disruption as possible

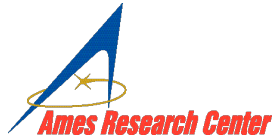
Tool

- Tool combines logic tables from operational procedure method with graphical design capability to create discrete simulations

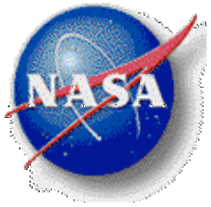




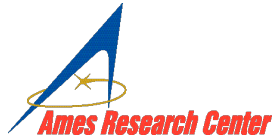
Logic Specification: (1)



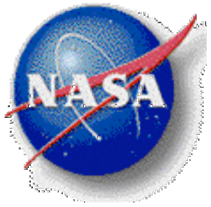
- Tables allow iterative build test functionality, because you can test one function at a time
- Tables specify entry conditions to machine behaviors which:
  - Requires user to completely specify machine behavior (useful for software development) (Comprehensive)
- Tables have hierarchy to build complex devices (Scalability)



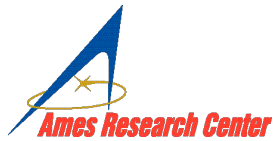
Logic Specification: (2)



- Representation allows for coverage tests (Comprehensive and HCI Integration)
- Representation can be used for many different types of devices (Scalability)
- Tool provides ability to attach natural language descriptions of machine behaviors (HCI Integration)



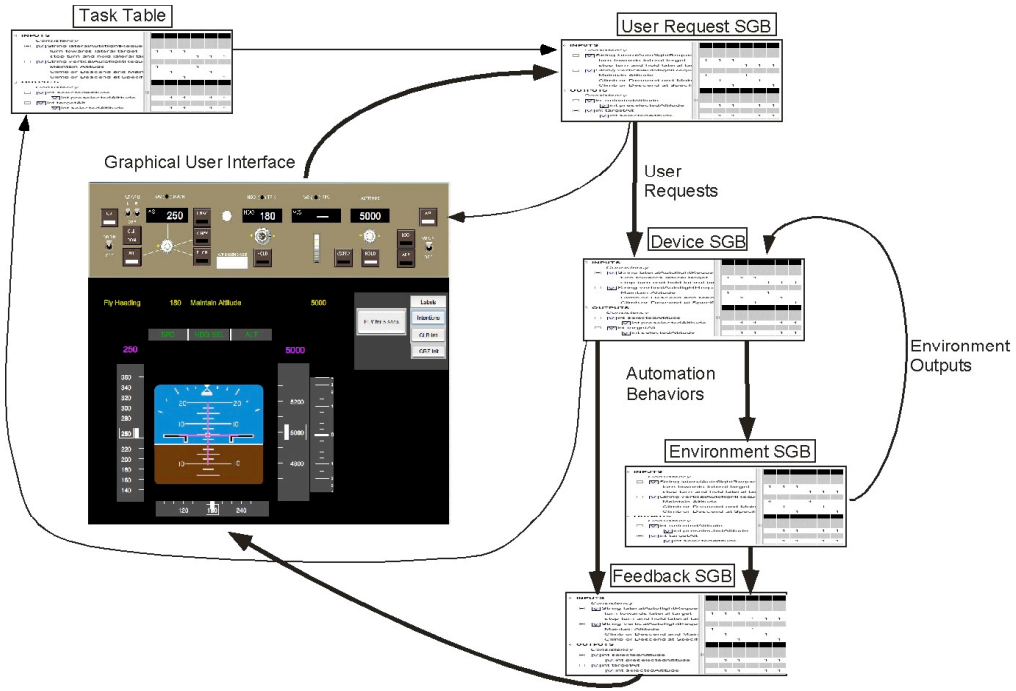
User Interface Development

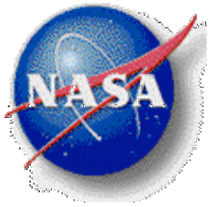


- Graphics objects are treated as system variables with properties in logic tables, so logic analyses are applicable
- Simple graphic objects can be built in tool
- More complex graphic objects can be built externally and imported
- Tool can handle static and dynamic graphical objects
- Allows for demonstration of a “dynamic storyboard” early while specifying requirements

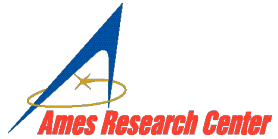
Tool Usability

- Users without formal programming experience but with domain knowledge able to build devices in tool

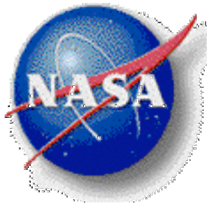




HCI Evaluation in Tool



- First analysis is coverage tests of logic for building interface conducted by designer from the very beginning of the design process.
- Traditional HCI evaluations can be conducted with an understanding of when the evaluation is complete (when all device behaviors have been examined).
- Additional automated analyses built into the tool provide evaluation of HCI problems that are not found by traditional usability evaluation or inspection methods



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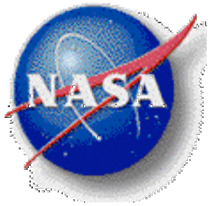
Response to Issues(1)

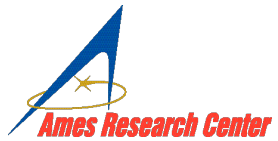
Ames Research Center

Scorecard so far:

- Reduce cost of use:
  - Limited data so far, but Tool has been used with 3-4 days of training
- Support Iteration:
  - Automatic Code Generator rapidly provides prototypes, and simulations have useful for demonstration and evaluation purposes
- Integrate HCI Evaluation:
  - Computational Analyses are being developed that can be used by personnel without an HCI background
  - Examine aspects of design not caught with current usability inspection methods



Response to Issues(2)



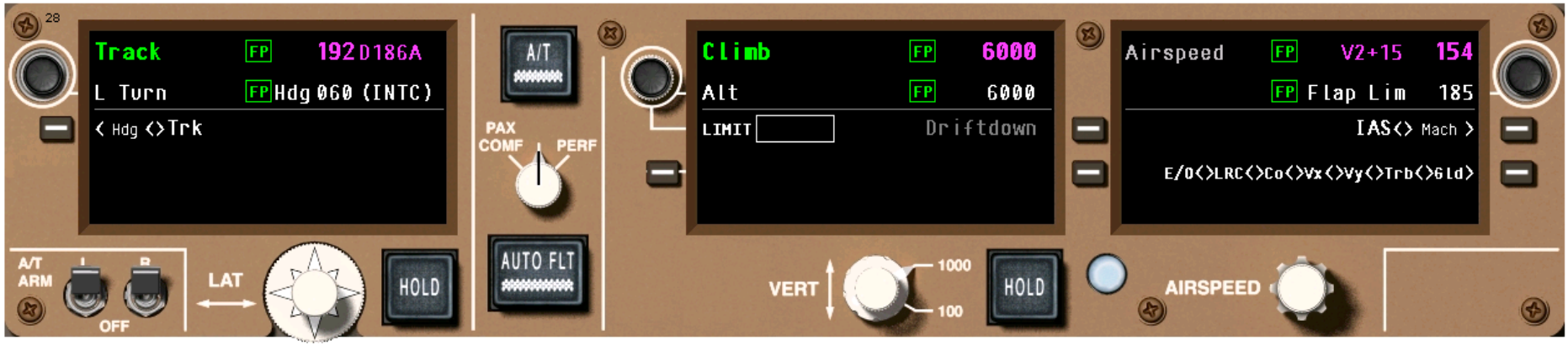
- Comprehensive:
  - Logic Tables allow evaluation of fit between machine behavior and interface behavior
- Scalable:
  - Ability to build and evaluate complex, dynamic devices, autopilots have been built

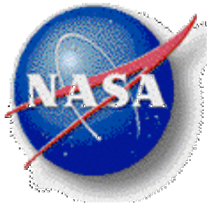
Response to Issues(3)

Ames Research Center

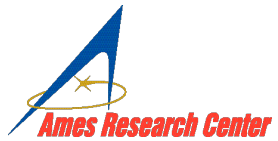
Boeing Concept Mode Control Panel designed in Tool

- Involved in development work from beginning of cycle on NFT -> Sonic Cruiser -> 7E7
- Development work for future Boeing airplanes
- Boeing Designers used tool and task design methods to develop new concept autoflight system

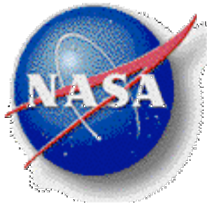




Ongoing Work



- Testing computational analyses to aid HCI evaluation by domain experts without HCI expertise
- Integration with simulation software
- Extension into Distributed Air - Ground Device Specification/Simulation



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Thank You for your attention